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Transforming food environments to deliver healthy diet options: Economic rationale and policy drivers

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CIAT Publication No. 483
October 2019

Mockshell J; Martey E; Etwire P; Khoury C; Prager S. 2019. Transforming food environments to deliver healthy diet options: Economic rationale and policy strategies. Working Paper. CIAT Publication No. 483. International Center for Tropical Agriculture (CIAT). Cali, Colombia. 14 p. Available at: https://hdl.handle.net/10568/105580

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Acknowledgments

This research has been supported by the flagship program “Food Systems for Healthier Diets” funded under the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) and the International Center for Tropical Agriculture (CIAT). Special thanks to Dr. Joe Tohme (CIAT Agrobiodiversity Research Area Director) for the motivation to conduct this review.

Abbreviations

FOCs	first order conditions
FRE	food retail environment
NCDs	non-communicable diseases
SDGs	Sustainable Development Goals

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Abstract

The second Sustainable Development Goal (SDG) envisions comprehensive global food security and improved nutrition by 2030. This is a major challenge, with persisting undernutrition and micronutrient deficiencies in multiple regions, and the increase in excessive consumption of macronutrients contributing to overweight and obesity, heart disease, and Type 2 diabetes even in low- and middle-income countries. While improvements are needed throughout current food systems, the food retail environment (FRE) in developing countries remains an underexplored link between production systems and consumers in food and nutrition security programs. This study examines the economic rationale of actors in the food retail environment and suggests policy options to nudge the food environment to deliver a healthier basket of foods. The policy options are classified into personal changes, private sector actions, and public sector initiatives. We argue that for a comprehensive transformation of the food retail environment to deliver healthier food options, private, public sector initiatives, and consumer awareness all require urgent action.

KEY WORDS

FOOD RETAIL
ENVIRONMENT
TRIPLE BURDEN
MALNUTRITION
MARKET FAILURE
SMART POLICIES
SUBSIDIES
FOOD TAXES


EL CARMELO
RELOJERIA
CITIZEN
Pacheco

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1. Introduction

About one billion people consume too few calories and other macronutrients and at least two billion people do not consume enough micronutrients while over 2.5 billion consume too much sugar, oil, and fat (Ingram and Zurek, 2018). Risk factors associated with non-communicable diseases (NCDs) (Type 2 diabetes, heart attacks, and hypertension) are high and the prevalence is increasing in low- and middle-income countries (FAO, 2016; Branca et al., 2019). Adult obesity is worsening in low- and middle-income countries, with an increase from 11.7 percent in 2012 to 13.2 percent in 2016 (FAO et al., 2018).

The nutritional content of foods available on the markets plays a major role in the health status of consumers, and by extension the prevalence of malnutrition. Increasingly, consumers in both urban and rural areas depend on the market (informal and supermarkets) for dietary needs (Reardon, 2015; Reardon et al., 2003; Weatherspoon and Reardon, 2003). Market factors contributing to malnutrition include cheap availability of low-quality and unhealthy food products in the retail market and limited access to nutritious food especially for consumers who have the resources to afford (Lartey et al., 2016; Global Panel, 2018). Economic factors, such as income, may influence the consumption of healthy diets as well as increase obesity and chronic disease when food environments facilitate spending toward unhealthy diets (Herforth and Ahmed, 2015).

Efforts to solve the current challenges regarding malnutrition and to achieve nutritional security have placed major emphasis on improving agricultural productivity. The focus has been on improving household nutrition and dietary diversity through several crop improvement and varietal selection strategies for grain legumes, cereals, and livestock (Becerril and Abdulai, 2010). According to Allen and de Brauw (2018), interventions focusing on agricultural productivity have had only partial impacts on nutrition security. The changing preferences of consumers due to urbanization have led to the incorporation of consumer traits in crop breeding programs to enhance acceptance and utilization. For example, improved biofortification (high iron in beans, zinc and protein in maize, and beta-carotene in sweet potatoes) is promoted as a strategy to enhance micronutrient composition in staple foods (Ruel et al., 2018). However, consumers may be constrained by their income in accessing high nutritious food. Preferences, individual beliefs, attitudes, habits, culture, information, and demographic status may affect the demand for specific food among consumers (Ventura and Worobey, 2013).

Market plays an important role in linking consumers to producers. In order to promote the consumption of nutritious foods, several studies have highlighted the role of value chain that focuses primarily on the food marketing chains (Maestre et al., 2017; Gelli et al.,

2015; Hawkes and Ruel, 2012). The World Wildlife Fund (WWF) has demonstrated how market systems can be enhanced in terms of their environmental and social impacts. However, there is paucity of information on how market systems can deliver healthy and nutritious dietary options partly due to the "philosophy" that markets simply offer what consumers demand. However, this philosophy is partly true. We address the gap in the literature by providing a framework that shows how forces of markets promote the production and consumption of nutritious foods. Patronage of retail markets, supermarkets, fast food restaurants, convenience stores and wet markets is increasingly becoming the norm because of increasing incomes, population growth, and rapid urbanization (Kennedy et al., 2004). This makes the food retail environment an important but not well-focused link between production systems and consumers (Reardon, 2015).

The findings from this study highlight the contribution towards achieving the Sustainable Development Goals (SDGs) (Global Panel, 2018). SDG2 highlights the need to "end hunger, achieve food security and improve nutrition and promote sustainable agriculture," SDG3 echoes the need to "promote good health and wellbeing," and SDG12 highlights the need for "responsible consumption and production" (United Nations, 2015). Together, these SDGs provide a strong case for the need to pay attention to the linkages between agriculture, food and nutrition security, and health. To emphasize the need for sustaining the SDGs, the market linkage between production systems and consumers must function properly to deliver healthy and nutritious food choices.

Presently, the food retail environment, especially in low- and middle-income countries, does not deliver the healthy dietary options needed to ensure nutritional security. This is due to the following failures: (1) consumer failure – the inability of individuals to make healthy food choices because of prices, substitutes, convenience, access, beliefs, availability, etc.; (2) market failure – the inability of the private sector to move toward providing healthier dietary options due to production costs, logistics, profit motives, etc.; and (3) public policy failure – the inability of governments to initiate and enforce regulations because of lobbying activities, beliefs, and limited political will. Turner et al. (2017) examined the concepts and critical perspectives of the food environment and showed that a paradigm shift is required to better account for the socio-ecological interactions that determine food acquisition patterns, diets, and nutrient and health outcomes. But the complexity of these factors and the limited understanding of the interactions taking place among the different actors (consumers, food suppliers, and the public sector) have made it challenging to clearly outline how to nudge the food retail environment to deliver healthier dietary options. This review aims to begin to unpack the food retail environment to achieve a better understanding of the economic rationale of actors in the food market as a fundamental step in starting to determine the policy strategies required to encourage and allow the food retail environment to deliver healthy diets in low- and middle-income countries.

In subsequent sections, we discuss the food retail environment conceptually and present its economic foundations, examine policy strategies to nudge the food retail environment to deliver healthier dietary options, and, finally, provide recommendations and areas for future studies.

Photo: CCAFS

2. Food retail environment: Theoretical foundations and economic rationale

We use a simple partial equilibrium model to demonstrate how market systems can deliver healthy and nutritious dietary options. In this model, we assume that there are producers who supply optimal bundle of food items that maximizes profit subject to cost of production while there are consumers $i=1,2,....I$ who choose the optimal quantity of the composite food item to maximize their utility subject to their budget constraint. Equilibrium is achieved when price equilibrates quantity supplied and quantity demanded across all units in the economy. Consider producers $j=1,2,....J$ providing composite food items A_{hj} (highly nutritious – fruits and vegetables) and A_{mj} (energy dense - maize) using unconditional inputs h_{kj} (capital) and h_{kj} (labor) with corresponding input prices of r_{kj} (price of capital) and r_{kj} (price of labor), then the cost and production function (which is increasing in input, concave, and linearly homogenous) can be specified as:

$$A_{kj} = f_k(h_{kj}, h_{kj}; z) \quad C_{kj} = m_{k1j}h_{k1j} + m_{k2j}h_{k2j} \quad \forall\, k = \{h, m\}$$

Eq. 1

Given the price vector $p_k=\{p_h,p_m\}$, where p_h is the price of fruits and vegetables (A_h) and p_m is the price of maize (A_m), the producers or firms (food retail environment) choose input bundles that solve the profit (π_{kj}) maximization problem for each of the firm:

$$\max_{h_{k1j},h_{k2j}} \pi_{kj} = p_k f_k(h_{k1j}, h_{k2j}; z) - r_{k1j}h_{k1j} - r_{k2j}h_{k2j}$$

Eq. 2

The first order conditions (FOCs) are:

$$\frac{\partial \pi_{kj}}{\partial h_{k1j}} = p_k \frac{\partial f_k(h_{k1j}, h_{k2j}; z)}{\partial h_{k1j}} - r_{k1j} = 0 \quad \forall\, k = \{h, m\}$$

Eq. 3a

$$\frac{\partial \pi_{kj}}{\partial h_{k1j}} = p_k \frac{\partial f_k(h_{k1j}, h_{k2j}; z)}{\partial h_{k1j}} - r_{k1j} = 0 \quad \forall\, k = \{h, m\}$$

Eq. 3b

Solving for (3a) and (3b) yields the optimal input demand:

$$h^*_{k1j} = h_{k1j}(p_k, r_{k1j}, r_{k2j}, z) \text{ and } h^*_{k2j} = h_{k2}(p_k, r_{k1j}, r_{k2j}, z)$$

Eq. 4

Substituting the optimal input in equation (1) yields the optimal output or supply of food items:

$$A^*_{k1j} = A_{k1j}(p_k, r_{k1j}, r_{k2j}, z) \;\; and \; A^*_{k2j} = A_{k2j}(p_k, r_{k1j}, r_{k2j}, z) \quad \forall\, k = \{h, m\}$$

Eq. 5

The above results show that producers will supply different quantity of the bundle of goods to maximize their profit. Several deductions are made to explain the food retail environment. First, consumers will choose the optimal bundle of healthiest food if prices faced by the consumers are in a ratio that perfectly aligns with the healthiest choice, which is an exceptional case. Promotion and consumption of highly nutritious food will only occur when the price of higher calorie foods (e.g., maize) is higher than the optimal, and the price of other nutritious foods that are currently under-consumed (legumes, fruits, and vegetables) is lower than the optimal. Second, decreasing the price of nutritious food will increase its consumption; however, high transaction costs of preservation and transportation, and change in prices due to relative productivity (increase in productivity of grains and decrease in productivity of legumes, fruits, and vegetables) will reduce the intake of nutritious and healthy foods. Third, higher levels of income are associated with greater consumption of nutritious food. However, preferences for and consumption of high-calorie food may increase despite an increase in income, which can result in excessive weight gain and obesity. In an imperfect market, prices, income, profit maximization, utility maximization, and many cultural and stochastic factors all drive food choices and the food retail environment. These findings align with what Allen and de Brauw (2018) found in their study on the theory of nutrition-sensitive value chains.

To incorporate the consumer's perspective, we modeled the consumer problem using the static labor supply model proposed by Blundell and MaCurdy (1999). The model integrates production, consumption, and investment in a single framework, assuming a household is a consumer of purchased composite goods, A_{hi} and A_{mi} and leisure L_i. A household maximizes a twice continuously differentiable quasi-concave preference function specified as:

$$U_i = U_i(A_{hi}, A_{mi}, L_i; X, Z)$$

Eq. 6

where the utility derived from consuming A_{hi},A_{mi},L_i is affected by household characteristics, X, and human capital, Z. Given that a household uses labor in home production, the household technology will be Q_i=Q_i (h_{k1i},h_{k2i};Z). Assuming the price for leisure is w, and the price vector of the food items demanded is p_c={p_d,p_n}, and the household is endowed with 24 hours (T), the full budget income constraint is expressed as:

$$p_d A_{hi} + p_n A_{mi} + wL_i \leq wT_i - wh_c + V \qquad \forall\, c = \{h, m\}$$

Eq. 7

where V is unearned income (transfers, remittances, etc.), p_d and p_n are the prices of fruits and vegetables and maize, respectively, and wT_i- wh_k= G. The budget constraint suggests a trade-off between consuming A_{hi}, A_{mi}, and L. The household chooses the optimal quantity of the food items and leisure to maximize utility. The consumers choose the optimal bundle of the goods (fruits and vegetables, and maize) that solve equation (8) as follows:

$$\mathcal{L} = U = U(A_{hi}, A_{mi}, L_i; X, Z) + \lambda(p_d A_{hi} + p_n A_{mi} + wL_i \leq G + V)$$

Eq. 8

Assuming interior solutions ($A_h > 0$, $A_m > 0$, and $L > 0$), the FOCs are:

$$\begin{aligned} U_{A_{hi}} - \lambda p_d &\geq 0 \\ U_{A_{mi}} - \lambda p_m &\geq 0 \\ U_{L_i} - \lambda w &\geq 0 \\ G + V - p_d A_{hi} - p_n A_{mi} - wL_i &= 0 \end{aligned}$$

Eq. 9

The optimal demand for fruits and vegetables, and maize obtained by solving equation (9) are expressed as follows:

$$A^*_{hi} = A_{hi}(p_h, p_m, w, G, X, Z) \;\; and \; A^*_{mi} = A_{mi}(p_h, p_m, w, G, X, Z)$$

Eq. 10

The equilibrium price (p^*_h, p^*_m) and quantity (A^*_{hi},A^*_{mi}) for the food items is obtained by equating the aggregate supply (Equation 5) to aggregate demand (Equation 10) as follows:

$$A^{s*}_{h1} = A^{d*}_{h1} \Longrightarrow A_{h1}(p_k, r_{k1}, r_{k2}, z) = A_h(p_h, p_m, w, G, X, Z)$$

Eq. 11

$$A_{m1}^{s*} = A_{m1}^{d*} \Longrightarrow A_{m1}(p_k, r_{k1}, r_{k2}, z) = A_m(p_h, p_m, w, G, X, Z)$$

Eq. 12

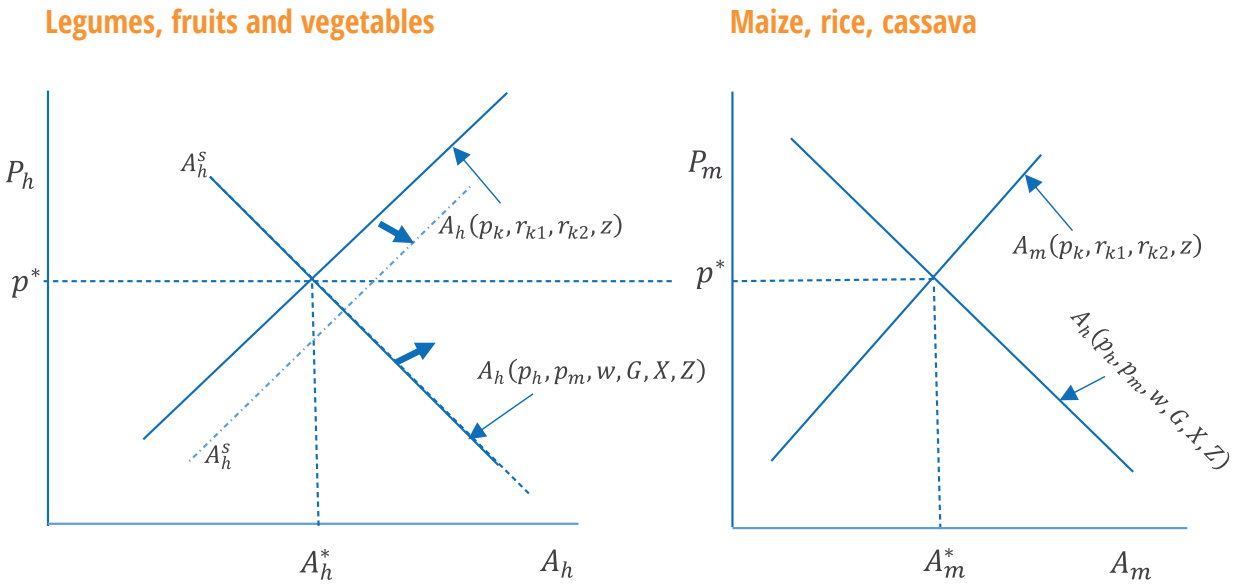

Figure 2 Equilibrium price and quantity demanded for fruits and vegetables and maize.
Source: Authors' construction based on analysis of food environment

Figure 2 shows the equilibrium price and quantity at which high-calorie foods (e.g., maize, rice, and cassava) and highly nutritious foods (e.g., grain legumes, animal protein, fruits, and vegetables) are made available by suppliers and are affordable to consumers. The equilibrium indicates that both suppliers in the food retail environment and consumers are satisfied with the price and quantity of the different food categories. Either a shift in the demand side factors (household characteristics, preferences, transfers, and remittances) or supply side factors (tax, firms' preferences and improved infrastructure) can lead to a change in availability, affordability, and accessibility of nutrient-rich food items. For example, an increase in household income can lead to an upward shift in the demand for both food types (maize and fruits and vegetables), leading to an excess demand over supply.

Equilibrium in the fruits and vegetables market is restored by an upward shift of the supply curve leading to a decrease in price and quantity demanded. The current food retail environment in low- and middle-income countries is characterized by the presence of highly processed food. The presence is mainly due to neo-liberal trade policy leading to their affordability to most low-income consumers with subsequent increase in consumer demand. For suppliers, the demand by consumers of long-shelf-life products and potential profit motives contribute to a higher supply of such products in the food retail environment compared with alternatives (substitutes). Limited product information and suboptimal food choices on the part of consumers have contributed to consumer failure. With the growth of the multiple burdens of malnutrition, there is an urgent need to deal with the consumer, market, and governance failures, and transform the food retail environment to deliver healthy diets. Based on this review of the concepts and economic theory, the next section examines the policy interventions to nudge the food environment to deliver healthy diet options.

Photo: Georgina Smith/CIAT

3. Policy interventions to re-adjust and nudge the food environment

Imperfect consumer choices and inadequate private and public investments on post-production systems have a negative effect on the food retail environment in low- and middle-income countries. In spite of all the substantial investments in productivity-enhancing agricultural research in developing countries (Alene et al., 2009), failures of the food retail environment persist due to the less than commensurate investments in that sector among other factors. Therefore, resolving the challenges in the food retail environment will require economic changes, institutional changes, and new policies as well as education and awareness creation among consumers.

3.1. The role of the public and private sectors and consumers in nudging the food environment

In a food retail environment, consumers have the ultimate choice to decide on a healthy or unhealthy diet. This choice can be constrained by prices, substitutes, convenience, access, beliefs, and availability, as discussed in Section 2. Civil society groups that represent consumers and aim to convince the public and private sectors to re-orient the food environment are often hindered by challenges (e.g., funds). The private sector is also affected by production costs, logistics, profit motive, and government regulations. In some cases, the private sector uses lobbying to influence the legislator or public initiatives to maximize firm benefits in the food environment, for instance, by influencing national dietary recommendations. The inability of the public sector to provide regulations and enforce laws also leads to government failure. For the food retail environment to function, all the different types of failure must be addressed and a more integrated policy process to address the challenges is required.

3.2. Policy strategies to nudge the food retail environment

Policy options to nudge the food retail environment toward delivering healthier dietary options are classified into personal changes, private sector actions, and public sector initiatives. We argue that for a real transformation of the food retail environment to deliver healthy diets, all three policy dimensions must be implemented with a tripartite goal. These policy options are discussed under four thematic areas: taxes, government incentives, food industry initiatives, and consumer attitudes.

3.2.1. Food taxes and subsidies

Fiscal measures relating to food taxes and subsidies can contribute to improving nutritional security and healthy diets by influencing producer supply and consumer demand. Positive effects of fiscal policies can be amplified if taxes for unhealthy choices (e.g., ultra-processed, sweetened beverages, and highly dense foods) are combined with subsidies for healthy options, such as fresh fruits, legumes, and vegetables (Global Panel, 2017). Taxes and subsidies can be used as effective

tools for nudging unfavorable food retail environments to deliver healthy dietary options. Imposition of a prohibitive tax on unhealthy options will likely result in increases in prices (as producers and suppliers will likely pass on the tax to consumers) and thus a decline in consumers' real income, purchasing power and, by extension, a decline in the demand and consumption level of unhealthy foods. As discussed in Section 2, producers and retailers will likely respond to the decline in demand (i.e., a shift in the demand curve to the left) by reducing production and supply (i.e., a shift in the supply curve to the left), respectively. A shift in the demand (supply) curve to the left will result in an excess supply of unhealthy foods and thus a decline (increase) in the price of such commodities. The net effect of a proportionate shift of the demand and supply curves to the left is no change in affordability but a decline in availability (new equilibrium quantities) of unhealthy foods.

Similarly, a subsidy implies a decline in price or an increase in real income or purchasing power. Hence subsidizing healthy foods (e.g., fresh fruits, vegetables, and grain legumes) will result in an increase in demand for such foods (i.e., a shift of the supply curve to the right resulting in an increase in the quantity and a decline in the price of healthy foods) thereby triggering a supply response in production and supply of heathy diets in the food retail environment. Consumers will likely respond to the decline in price (or increase in disposable income for consuming healthier foods) thereby shifting the demand curve to the right. The net effect of a proportionate rightward shift of the demand and supply curves is zero change in price but an increase in the availability of healthy foods.

Photo: Georgina Smith/CIAT

Instead of implementing a fixed tax or subsidy, one option could be to implement a discriminatory or progressive tax and subsidy policy through which vulnerable groups could enjoy bigger subsidies on healthy foods. In addition to subsidizing or taxing foods, the food generation process itself can be taxed or subsidized to deliver healthy options. The imposition of taxes on research and development of unhealthy foods or the imposition of subsidies on research and development of healthy foods (e.g., crops with low glycemic indices, high iron, etc.) would increase the availability of healthy diet options. For developing countries, subsidies for fruits, vegetables, or other more nutritious foods remain largely conceptual at this stage (Allen and de Brauw, 2018) due to competing and rather high demand on public funds. Where subsidies are implemented, cost, governance, and institutional challenges in managing such programs have been critical components in ensuring the success of the subsidy program.

3.2.2. Government incentives

National governments have ample opportunity to reduce the public, market, and consumers' failures. This can be achieved through nudging the food retail environment to deliver healthy dietary options. Governments could enforce labelling, regulations, and standards to support consumer decision making. Accurate labelling enables health-conscious individuals to avoid unhealthy foods or opt for healthy foods, thus leading to a fall (increase) in aggregate demand for unhealthy (heathy) options. In the long run, producers and suppliers will readjust to meet the rise or fall in demand. Through public sector policies and effective reporting mechanisms, misleading food labels can be reported. Lessons in implementing such food labelling in developed countries can be adopted by low- and middle-income countries. The evidence suggests large companies with a range of products have been shown to respond to labeling policies strategically as labeling costs are relatively minor for them. Smaller firms that are likely to be responsible for a significant amount of food share in a developing country could find it more difficult to comply with labeling policies. Therefore, governments need to be attentive to the challenges that small and medium enterprises face in complying with labeling policies, and it may be necessary to make special provisions for them (Albert, 2016).

State, territory, and local governments should, where possible, ensure strict zoning for different types of food businesses to ensure that for each food business zone there are retail outlets that deliver healthy food options. This will likely make healthy food options easily available and accessible (i.e., improvements in food supply)

thereby increasing consumers' choice sets for a healthy food basket. National governments could reorient their food, nutrition, and agricultural policies to encourage diversity, nutrition, sustainability, and affordability, rather than only prioritizing a small number of staple crops, such as maize, rice, and soybean. Increasing diversity in the food environment will likely improve accessibility and affordability as more food options or food supply tend to be inversely correlated with price.

Major constraints to high-quality diets are high transaction costs and unreliable, or a lack of, supporting infrastructure, such as remote roads and electrical- and water-grid networks. In developing countries, where food loss is a major issue, investing in better infrastructure, particularly cooling and storage facilities, is paramount (Global Panel, 2018). To reduce the high transaction costs and ensure high volumes of production and diversity of crops among producers, the public sector can partner with private institutions through public private partnerships (PPPs) to provide improved storage techniques and infrastructure and complement an effective price information system. This will improve supply, thereby, shifting the supply curve to the right leading to improved availability (an increase in the new equilibrium quantity) and affordability (a decline in the new equilibrium price).

3.2.3. Food industry initiatives

The food retail environment and food industry actors can take steps to implement measures that improve the delivery of heathy diets. In developed economies and part of low- and middle-income countries, food industry actors due to public sector support have broadly implemented sodium/salt reduction. This has been an important and cost-effective way of reducing the risk of cardiovascular diseases and hypertension. In addition, food advertising and marketing is a powerful behavioral change mechanism that attracts heavy investment from the private sector, charities, civil groups, and governments. The amount that food and beverage companies invested in advertising in 2012 was 17 percent of all global media spending (Global Panel, 2017). These advertisements were mostly used to promote the consumption of less healthy foods and beverages targeted at children. Food industry actors could use these advertisements to instead promote the sale of heathy foods without compromising profits[1] and people's health. In all countries, there is a need to improve the design of labels to make them accessible and appealing to all types of people. Improving label legibility is a relatively quick way to improve the way consumers use nutrition information.

3.2.4. Consumer attitudes

From a demand side perspective, consumers have the ultimate responsibility to make healthy food choices and hold the power to influence the types of food that are delivered by the food environment. The ability of consumers to make sound food choices has been affected by personal and external/institutional limitations. In some cases, the limited amount of information has hindered consumers' ability to make food choices. Consumers have the power to influence the food environment through demand for healthy diets: opting for more fruits, vegetables, nuts, legumes, whole grains, and livestock products. It is also important for consumers to eat a variety of food not only to obtain a diversity of nutrients but also to support biodiversity in the food system. Consuming too much food can lead to weight gain and other health problems thereby posing greater challenges to the environment. Taking the time to share meals with family and friends and choosing single serving portions are two simple ways to avoid overeating.

Photo: Georgina Smith/CIAT

[1] Rather than engaging in competitive advertisements, individual actors who retail healthy foods could jointly promote the consumption of healthy foods in general.

Photo: Stéfanie Neno and Adriana Varón/CIAT

Conclusion

Relying on only production systems or consumer awareness and educational interventions alone will not have the impact required to improve nutrition security and achieve the SDGs. The food retail environment – the under-examined interphase – is critical to solving the malnutrition problem in low- and middle-income countries. As the evidence suggests, in the market environment, consumers make food choices to maximize utility and suppliers supply food to maximize their profit. Although the market will adjust to establish an equilibrium, this might not necessarily be the pareto-efficient[2] option for society. This is largely because of persistent market, government, and consumer limitations. The current limited understanding of the political economy of the food environment as well as economic analysis on healthy diets, modelling consumer choices, and future consumption scenarios are knowledge gaps that future research should address. We argue that for the food retail environment to deliver healthy dietary options and satisfy the nutritional needs of society, consumers and the public and private sectors must work together and take action now.

[2] Pareto-efficiency is the condition where it is no longer possible to improve the welfare of an actor in the food retail environment without making other actors worse off.

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